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Construction and Arrangement of Milk Plants[1]

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INTRODUCTION

Milk produced for consumption in fluid form in cities and towns is usually shipped from the country to a city milk plant, where it is inspected, pasteurized, and otherwise prepared for sale as milk or cream and delivered in suitable-sized containers to retail stores or directly to the individual consumers.

In order to fulfill its purpose satisfactorily, the milk plant should be a modern sanitary building of durable construction. It should have sanitary and up-to-date equipment, and the arrangement of the building and equipment should be such that all operations can be conducted efficiently and economically.

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[1] This circular is a revision of and supersedes United States Department of Agriculture Circular 228, Construction and arrangement of city milk plants. It also supersedes United States Department of Agriculture Circular 214, Small plants for pasteurizing milk.

[2] Now with the Dairy Branch, Production and Marketing Administration.

Information about the operation and management of milk plants is given in another publication issued by the Department of Agriculture.[3] The purpose of this circular is to furnish specific information about the construction and arrangement of modern milk plants, as an aid to those who wish to build new plants or to remodel old ones.

PRIMARY CONSIDERATIONS IN ESTABLISHING A PLANT

Many milk plants have failed, not because of faulty management or changed conditions, but because conditions were not satisfactory for the establishment of a milk plant in the first place. Before the prospective operator engages in the milk business he should have satisfactory answers to the following questions.

What will be the probable spread or margin between the prices paid for raw milk and the prices received for bottled milk, cream, and other products to be marketed, and will it be possible to operate the business on that margin?

Is the man who will be in charge of the plant familiar with the milk business? Unless a capable manager can be obtained, the chances of success will be greatly lessened, as the success of a milk business depends primarily on the manager.

Is enough capital available to equip a modern sanitary plant and operate it until it reaches a paying basis?

Is a sufficient supply of milk of proper quality available, or can enough be made available to operate the plant successfully?

Is there a steady demand for milk in the locality under consideration, and is this demand being met by dealers already in the business?

What type of competition will be encountered?

What is the attitude of the local health department? A capable health department can be of great help to a plant that is putting out a high-quality product.

What is the local labor situation? Can reliable help be obtained?

Are the householders in the community able and willing to pay a fair price for a high-quality product? Do they pay their bills promptly?

Can the community be induced to use more milk? Will it be possible to work up a trade in other products, such as cream, buttermilk, butter, and cottage cheese?

There are also minor considerations; but if the conditions implied in these questions are favorable the advisability of establishing a new plant in the vicinity will be greatly increased.

HINTS TO PROSPECTIVE BUILDERS

The construction of a milk plant requires careful study and planning. The building represents a large investment, and it is important that the plans be laid carefully. The efficiency of the plant will depend to a large extent on the type of equipment used and also on the arrangement of the various rooms and machinery. It is possible in a well-arranged plant to effect great economies in labor while a poorly planned plant may become a continual source of extra expense because of the excessive labor required.

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[3] Babcock, C. J., OPERATION AND MANAGEMENT OF MILK PLANTS. United States Department of Agriculture Circular 260, 58 pp., illus, 1947.

Anyone who contemplates building a new plant will do well to visit various up-to-date plants in different cities and to observe the general construction, lay-out of rooms, and equipment. If it is impossible to visit other plants, plans and specifications for modern plants sometimes can be obtained and ideas gained from them. By combining the ideas of other operators with his own, the prospective builder can usually incorporate the best features in the new plant.

After the prospective builder has selected a site for the plant and determined about what is needed, he should explain his general plan to a competent architect and have the architect draw up tentative sketches and plans, which then may be studied in detail. Of course, it is desirable that he should have decided previously on the type of machinery to be used, since the general arrangement of the plant will depend to a considerable extent on the type of machinery used. If this decision is not made in advance, it may be well to have several plans drawn, each adapted to the use of a particular type of machinery.

In case it is found necessary to make changes in the plans, they should be made before construction has begun, as it is expensive to make alterations in a plant after its erection. It would be well, also, to have the preliminary plans reviewed by others experienced in the business and by health officials before final plans are drawn.

For plants of small capacity less detail is necessary and such plans frequently can be completed without the aid of an architect.

LOCATION OF PLANT

The principal points to bear in mind in locating a plant are: (1) Ease of access from as many sides as possible, (2) value of property, (3) cost of getting milk to the plant, (4) proximity to distribution center, (5) advertising possibilities, (6) opportunity for retail-counter cash trade, (7) nearness to city water supply, sewage connections, and electric power, (8) avoidance of heavy traffic surroundings, (9) good drainage, and (10) pure air and clean surroundings.

Ease of access to the plant is very important (fig. 1). If a plant cannot be approached from at least two sides, it is difficult to arrange it economically and conveniently. A plant on a corner lot with an alley in the rear is desirable, but is not always obtainable in the downtown section of a large city without great expense. In small cities it would be well to consider the possibility of locating the plant on a well-traveled thoroughfare. A well-located plant may easily make up more than the difference in first cost of the plant site, through increased returns from counter sales and greater advertising value.

The size of the lot depends on the size of the plant to be built, the shape of the lot, and the location. Access to the plant by trucks is essential. An inside lot will require a right of way to the plant and parking and turning space alongside the plant. This extra space is often unnecessary where the lot has one or more sides fronting on streets or alleys. Rectangular lots provide more usable space than triangular or irregular lots of the same area. Plants of large capacity, of course, require more ground space than plants of smaller capacity.

Table 1 shows the average ground space covered by 96 plants of

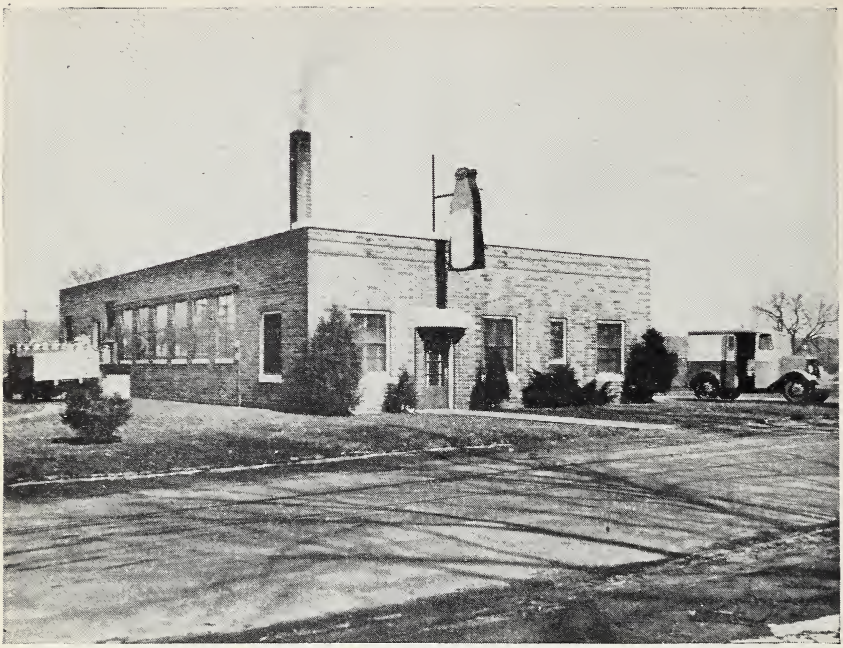

FIGURE 1.—A small milk plant that can be approached easily from three sides.

various sizes. This space includes the boiler room, refrigeration-machinery room, and milk-storage room, but does not include the garage. The ground space must not be confused with the floor space in the plant, which depends on the number of floors as well as the ground area.

TABLE 1.—*Average ground space of 96 milk plants, grouped according to quantity of milk handled daily*

Plants grouped by quantity of milk handled daily	Plants	Quantity of milk handled daily per plant		Range of ground space	Average ground space	
		Average	Range		Per plant	Per 100 gallons of milk
	Number	*Gallons*	*Gallons*	*Square feet*	*Square feet*	*Square feet*
200 gallons or less	36	133	68– 200	364–1, 632	790	656
201 to 500 gallons	36	331	225– 500	582–2, 034	1, 132	353
501 to 2,000 gallons	24	908	600–1, 800	1, 320–5, 798	2, 450	284

With the larger plants the cost of getting the milk to the plant is an important consideration. If the bulk of the milk is to be received by railroad, it may be advantageous to build the plant near the railroad; but if the milk is to be received largely by trucks, such a location is not so important. Large plants are sometimes established near the railroad, so that the milk may be received directly from tank cars.

If a large quantity of milk is to be handled, it is usually desirable to establish the plant at the most convenient place for receiving the milk and to establish distributing branches in the residential sections of the city. By having one large plant economies can be effected in the pasteurizing and bottling of the milk and the bottled milk can be transported in large trucks to the distributing branches, from which it is sent out on the delivery trucks. The use of large trucks and trailers for transporting milk to the distributing centers is less expensive than the use of small delivery trucks. Furthermore, accounting departments are usually established at the branch plants to facilitate the keeping of the customers' records and the checking of the route men.

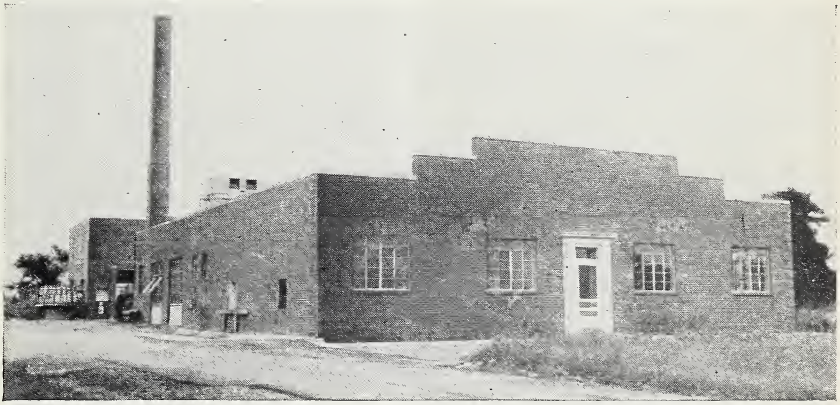

FIGURE 2.—Milk plant located on a lot of ample size in an outlying section of a city.

As a rule, where branch distributing plants have been established in conjunction with the main pasteurizing plant, the main plant will be nearer the wholesale trade, and most of the wholesale milk-delivery routes will be supplied by it, whereas the majority of the retail milk-delivery routes will be supplied from the distributing branches.

Some dealers plan to establish their plant in or near a section of the city where considerable development is anticipated. In this way they endeavor to obtain the trade of people moving into that section, and the plant itself acts as an advertisement.

In few cities is any difficulty encountered in getting an adequate supply of water and electricity; nevertheless, it is well to consider these items.

Congestion of traffic is of small consequence in a small town, but in a large city it may assume considerable importance.

Good drainage and clean surroundings are essential for an up-to-date plant. Some plants have been located opposite parks so that the air may be comparatively free from dust. At plants in a thickly settled part of the city it is often necessary to filter the air that comes into the building.

In recent years the tendency in building milk plants has been to establish the plant in a section of the city where the cost of property is not excessive and where a lot of ample size can be obtained, so as to make provision for subsequent expansion. (See figure 2.) Furthermore, a one-story building, which is more economical in labor requirements than a multiple-story building, requires a larger area of land than a multiple-story plant of the same capacity.

CONSTRUCTION

Number of Stories

In planning a milk plant, the building should be made large enough to accommodate a reasonable expansion of business. If it is practicable to do so the building should be so laid out that the capacity of the plant can be increased as desired by adding more units of machinery from time to time, without interfering with the convenient arrangement of the apparatus. Some plants are so designed that another story can be added if increased capacity is needed.

The type of building to select will depend somewhat on local conditions and on the type of machinery to be used. The most common type for small plants is the one-story building. The next most popular type is the one-story building with a mezzanine, or balcony. Both types permit economy of labor and time in handling milk. The mezzanine type makes it possible to use gravity either to flow the pasteurized milk to the bottling machine, or to flow the raw milk to the pasteurizer. This eliminates at least one pumping, and also extra machinery and piping. Although this type of building is adaptable to plants of all sizes, it is seldom used for plants receiving less than 2,000 gallons of milk daily. The mezzanine gives the advantage of extra floor space without increasing the ground space or man and labor requirements. Furthermore, plants of this type can be so arranged that the pasteurizing and bottling departments are in full view from the street.

The principal advantage of building a plant more than two stories high is the smaller ground area needed, a decided advantage when the plant is in a thickly settled part of the city. There is an increasing tendency to build in outlying sections, however, and the more recently established plants are mostly only one or two stories high. There are but few advantages in a higher building.

While the size of the plant as well as the number of stories depends on the quantity of milk handled, the arrangement of the plant should be such that each man can remain on one floor and not have to go from one floor to another in doing his work, a procedure which consumes much time.

Construction Materials and Finishes

Any of the ordinary building materials may be used in constructing milk plants. One of the principal factors to keep in mind is that the inside of a milk plant must be waterproof and easy to keep clean. The choice of material will depend largely on prices and on the supply of materials at hand, but it will also vary with different sections of the country and local building regulations.

WALLS AND CEILINGS

For the inside walls and ceilings, a material should be selected that will provide a smooth, easily cleaned, durable, waterproof surface. Rounded corners are preferable to square corners from a sanitary standpoint. For the inside walls of rooms where milk is handled, enamel brick, tile, enamel cement, or cement plaster is satisfactory. The tile or enamel brick is preferable but more expensive. Prepared hard plaster is unsatisfactory for either walls or ceilings where there is much moisture. Where a plaster finish is desired, cement plaster should be used rather than ordinary plaster. Where the wall is constructed of hollow tile, brick, stone, poured concrete, or concrete blocks, a fairly satisfactory surface may be obtained by applying cement directly to the surface of the masonry.

Some of the commercial gypsum wallboards give acceptable service if they are kept well painted. Composition wallboard frequently warps and pulls loose from the nails.

Wooden walls and ceilings are very common in small plants. If wooden walls or partitions are used, a concrete base or concrete apron should extend about 2 feet up the wall from the floor. This will facilitate cleaning, make the plant more sanitary, and protect the wooden walls from water and consequent rotting.

Metal walls and ceilings have a tendency to rust and become insanitary. Many health departments discourage the use of metal for either walls or ceilings.

FLOORS

Proper floor construction is very important in a milk plant. The floor must be hard-surfaced to resist wear; it must be waterproof, smooth, easily cleaned, and well drained.

Some form of concrete floor with a waterproof finish is the type most commonly used. A concrete floor meets all the requirements and is comparatively inexpensive. It should have a coved base against all vertical walls to facilitate cleaning. Concrete floors should be laid on a good foundation, about 5 inches thick, and should be made up of 1 part cement, 2¼ parts sharp, clean sand, and 3 parts crushed stone or gravel. The surface should be troweled hard and smooth. One objection to concrete is that the lactic acid of the milk will pit the cement. In those parts of the plant where there will be extra heavy wear on the floor, as from rolling cans and trucks over it, iron grids should be placed in the concrete with the tops flush with the top of the floor.

Floors with emery incorporated in the concrete to resist wear have proved satisfactory. Iron and steel chips incorporated in the concrete are seldom satisfactory as the chips rust out and leave the floor pitted. Solid iron plates are often used instead of grids, but they are harder to anchor to the concrete and consequently become loose and collect milk and dirt under them, causing foul odors and insanitary conditions.

A tile floor is desirable in the bottle-filling room. Although a tile floor is more expensive than a concrete floor, it has a good appearance and is durable, easy to clean, and very sanitary. The usual objection to these floors is that the tiles become loose and the material between the joints chips out. Proper construction retards the occurrence of these defects. Tile flooring should be laid over a concrete base. The setting base may consist of 2 parts of clean sand and 1 part of cement mixed with as little water as possible or one of the special bedding compounds recommended by the manufacturers of tile flooring. The tile should be spaced not more than one-fourth inch apart and the joints pointed with asphalt or other acid-resistant grouting. These floors will last practically indefinitely, since the tile will show little wear. It is often necessary, however, to repoint the joints when they start to crumble—before the tiles have a chance to slip. This is done by cutting out the disintegrating grouting and refilling the joints with new grout. The floor can thus be restored to its original condition without shutting down the plant or greatly disturbing plant operations.

Terrazzo and wood are not so satisfactory for floors in milk plants as concrete and tile. Terrazzo floors in the workrooms are soon pitted by lactic acid and hard wear. In rooms where milk is handled, wooden floors are short-lived because of the wear and rot; and they are also undesirable because milk soaks into the wood and between the cracks, causing bad odors and insanitary conditions.

Good drainage is essential. Floors in the milk-handling rooms should have a slope of about one-fourth inch per foot toward the floor drains. Drains should be properly located, trapped, and connected with the sewer before the floor is laid, in order to insure a correct slope of floor. The openings should be from 6 to 8 inches wide and should have perforated, removable covers. In some plants the floors are sloped toward the outside walls, with the drains along the sides of the room. Great care should be taken in laying the floor to avoid hollows in which water may collect. Before having the plumbing installed, be sure that the specifications conform to local plumbing regulations.

MILK-STORAGE OR COLD ROOM

The milk-storage or refrigerator room must be well insulated to keep the milk always at a low temperature. The most commonly used insulating materials are cork board, mineral wood, vegetable fiber, sawdust, and shavings, which are used in combination with wood, cement, masonry, and air spaces. Cement plaster should be applied over the inside walls and ceilings in order to protect the insulating material from moisture. One of the most satisfactory types of construction is about 4 inches of cork board insulation (6 inches is better, and more is seldom necessary) with cement plaster applied on the inside. Whatever insulating material is used, it should be placed in each of the side walls, the ceiling, and also in the floor. The floor of the milk-storage room should be of concrete laid solidly on the insulating material. Good drainage to a drainpipe, carefully trapped to prevent warm air from entering the room, is very important.

In order to save refrigeration the milk-storage room should be located a reasonable distance from the boiler room and only a minimum of wall surface should be exposed to the outside air or sun. The doors of the room should fit tight, swing outward, and be adapted to quick handling. A vestibule, while taking up some extra space, will prevent considerable loss of refrigeration.

TYPES OF PLANTS

Milk plants may be classified according to the method by which the milk is handled in the plant and also by the course of the bottles through the plant.

In a large number of plants, especially those of small capacity, all operations are on one floor level and one or more pumps are used to handle the milk. Modern milk-plant equipment is adaptable to the one-floor plan and where ample ground area is available this type of plant has many advantages.

In plants where the milk is handled on more than one floor, the most common practice is to receive it on the first floor and pump it to a higher level (fig. 3). The milk is then handled by gravity or by a combination of gravity and pump. It has been found more economical and satisfactory to pump the milk than to elevate it in cans by means of elevators or escalators. If the pump is of proper design and is kept clean, there is no great objection to pumping the cold raw milk from a receiving tank on the first floor to the raw-milk storage tanks or to the pasteurizing department. The economy of dumping the milk and washing the cans on the first floor is of considerable importance, and much labor, time, and power may be saved by handling cans in that way rather than elevating the full cans and, after they have been dumped, sending them back on an elevator or escalator. Only in plants where there is not room enough on the ground floor for weighing, sampling, and grading should the milk be sent upstairs in cans.

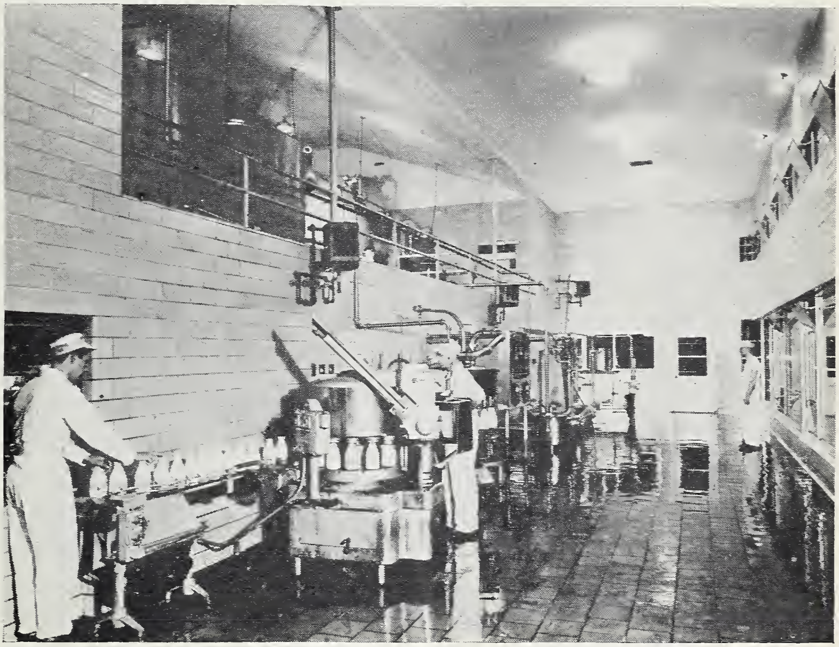

Figure 3.—Interior of a one-story and mezzanine or balcony plant. The milk is received on the first floor and pumped to the storage tank on the mezzanine.

Another type of plant that is proving satisfactory is one in which the milk-storage tanks are located on a floor below the street level. This arrangement has some advantages, especially where the milk is transported to the plant in tank trucks or tank cars, from which it may flow by gravity into the storage tanks; furthermore, space is saved in other parts of the plant. The milk is pumped from the storage tanks to a higher floor level, then handled by pumps, gravity, or by gravity and pumps from that level. This system should be used only where there is a basement that can be kept clean readily and where there is sufficient floor space to provide easy access to the tanks for cleaning. Placing the storage tanks in pits below the first floor is not satisfactory. It is difficult to clean the tanks properly and to keep the pits free from foul odors and in a sanitary condition.

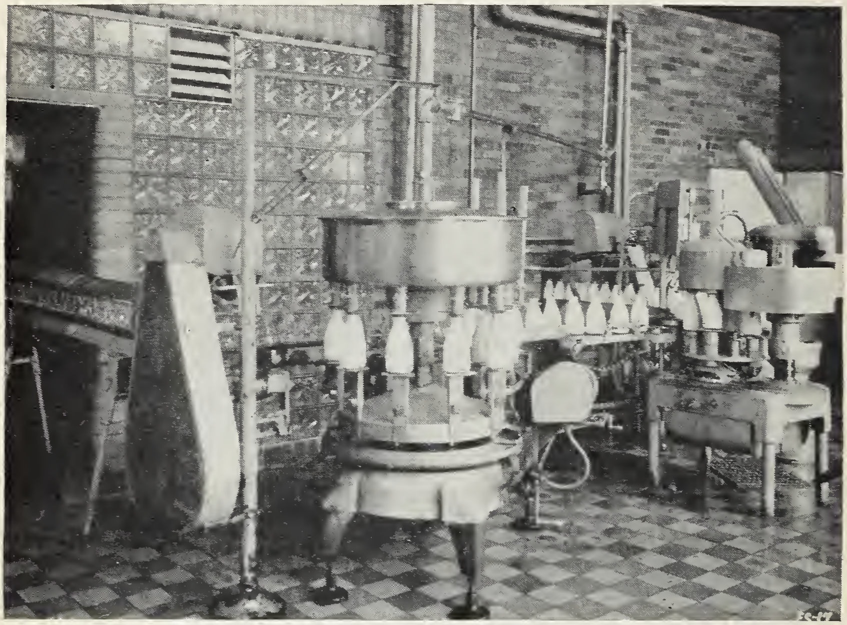

FIGURE 4.—At this plant the bottles are conveyed from the washer to the filler, capper, and hooder, and then into the cold room all on one floor. Note that the washed bottles are protected by a cover over the conveyor.

Milk plants may also be classified according to the method by which the bottles are handled in the plant. In small plants, and in a large percentage of the larger plants, the bottle washing and filling departments and the milk-storage room are all on the first floor (fig. 4). With this type of plant, transfer of bottles between floors, which causes extra breakage, is eliminated; and less labor is required than in plants where the operations are performed on different floor levels.

Another plan sometimes used to save first-floor space is to install the bottle washer in the basement and have the filling department and the milk-storage room on the first floor. This arrangement gives practically as good results as where all of the operations are on one floor, provided proper conveyor systems are used for conveying the dirty bottles to the washers in the basement, and the bottles, after being washed, are automatically elevated to the first floor by the washer itself. If the plant is equipped with power conveyors, properly installed, for moving the bottles to the basement, the number of bottles broken in sending them to the washers need not be large. Where gravity conveyors are used without automatic control, however, considerable breakage may result.

Other types of milk plants in use are: (1) Those in which the bottles are washed and filled on the second floor and the milk-storage room is on the first floor; (2) those in which all operations are on the first floor, except that the empty bottles are stored on an upper floor level or in the basement; and (3) those in which the bottles are washed in the basement, the fillers are on a floor above the first-floor level, and the milk-storage room is on the first floor. These types are not satisfactory and they are not in common use, although they are found occasionally in sections of larger cities where land is expensive or where sufficient ground area is not available to install a plant with enough space on the first floor to carry on all the operations.

ARRANGEMENT OF PLANT

In arranging the rooms and equipment, economy of operation as well as sanitation must be considered. The rooms and equipment should be so laid out that the men can perform their work with the fewest possible steps and the space will be used most economically. The equipment should be so arranged as to permit easy access for cleaning. It requires more time and labor to clean places that are difficult to reach, and they are likely to be neglected.

Another point to be considered in arranging the rooms and machinery is the reduction to a minimum of pumps, pipes, and fittings. Long lengths of piping and numerous fittings are expensive, cause extra labor, and tend to increase the loss that may result from milk sticking to the sides of the pipes and from leaks at joints. Also, milk piping may be insanitary if it is not cleaned regularly. Wherever milk piping is used, it should be of simple and sanitary construction, with frequent unions so that it may be disconnected readily for cleaning. It is important to have all turns in the pipes easy to reach and easy to clean. Elbows and tees are to be avoided as much as possible, but when they are used, openings at the end will facilitate cleaning. Right-angle bends may be used if there is sufficient space. There is less resistance to the flow of milk in bends than in elbows. Also, bends are more easily cleaned than elbows, as there are no recesses in which dirt can collect.

The course of the milk through the plant should be as direct as possible from the receiving tank, through the processing and bottling equipment to the milk-storage room, and out to the delivery trucks. Mechanical conveyors should be used wherever labor and time can be saved. In the smaller plants, however, it is sometimes more economical to use dollies for transporting cases of filled bottles from the filler into the cold room and from the cold room to the loading platform.

By careful planning, the overhead and the labor in milk plants may be reduced considerably. Usually the best procedure in building a plant is to select equipment of the type and size desired, plan the most convenient and efficient arrangement for the equipment, and then plan to erect the walls and partitions with respect to placement of the equipment.

Division of Plant Into Rooms

For economy of operation and sanitation, a division of rooms is essential in the modern milk plant. Both small and large plants should have a separate receiving room, bottle-washing room, milk-handling room, and milk-storage room, as well as a separate office and salesroom. The boiler room should be entirely separate from the rest of the plant and, if possible, in a separate building. Large plants often have a somewhat more detailed division of rooms than small plants.

MILK-RECEIVING ROOM

The milk-receiving room will contain the weigh can, scales, milk-sampling outfit, and either a rack or closet for the milk samples. The can-washing equipment should be located either in the receiving room or in an adjoining room. The receiving room should be so arranged that the milk can be received and weighed with a minimum of labor. Time and labor can be saved by using conveyors to transfer the cans of milk from the receiving room door to the dump or weigh can (figs. 5 and 6). The cans may be dumped by hand, and then placed directly in the can washer which delivers them automatically to the trucks either directly or by means of conveyors. Transferring the cans of milk from the receiving door to the weigh can either by rolling them or by using platform trucks requires extra time and labor.

SIZE OF ROOMS

Each room in the plant should be large enough to avoid crowding of machinery or workmen, but at the same time there should be no unused space, for that causes extra labor in getting the milk from one piece of apparatus to another, and necessitates added investment.

There is a wide variation in the size of the various rooms in milk plants, as well as in floor area per 100 gallons of bottled milk handled daily. These variations are due in a large measure to the lack of standardization of milk plants, and to the fact that many plants have been constructed without consideration of important factors bearing on the size of rooms.

It is important that the receiving room be of ample size. A small receiving room soon becomes cluttered with cans and other objects, and is difficult to keep clean and attractive. At small plants, the room should be large enough to receive at least one truck load of milk in cans, either on conveyors or otherwise, with plenty of room to handle the cans without crowding. At the larger plants, it often happens that several truck loads of milk in cans will arrive within a short period of time, and it is advisable to have a receiving room large enough to store this number of cans, either on the conveyor or in stacks, until they can be dumped.

The size of the bottle-washing room will depend on how the bottles come in from the delivery trucks. If most of the bottles are sent directly from the unloading platform to the bottle washers, the room need be only large enough for the conveyor and the bottle-washing

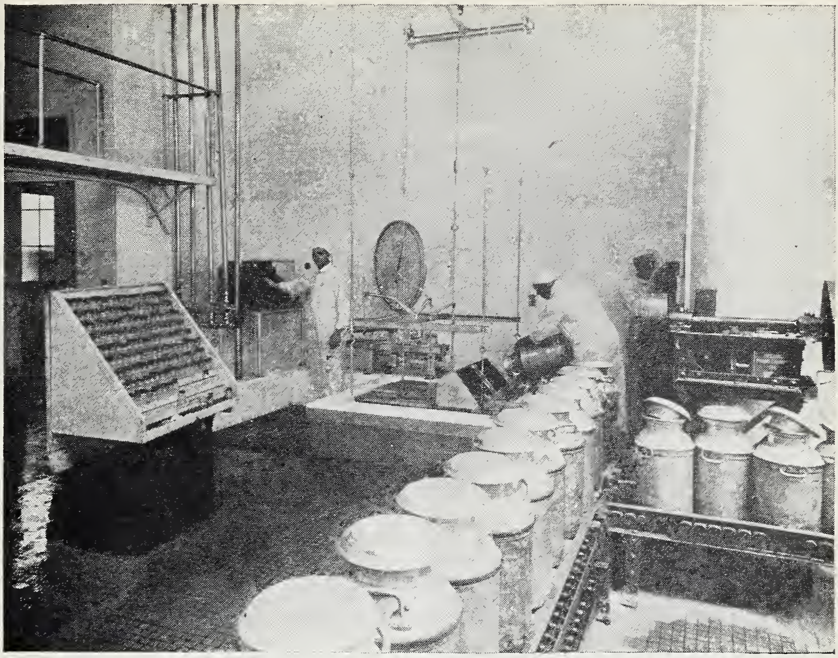

FIGURE 5.—Receiving milk at a plant using a conveyor system.

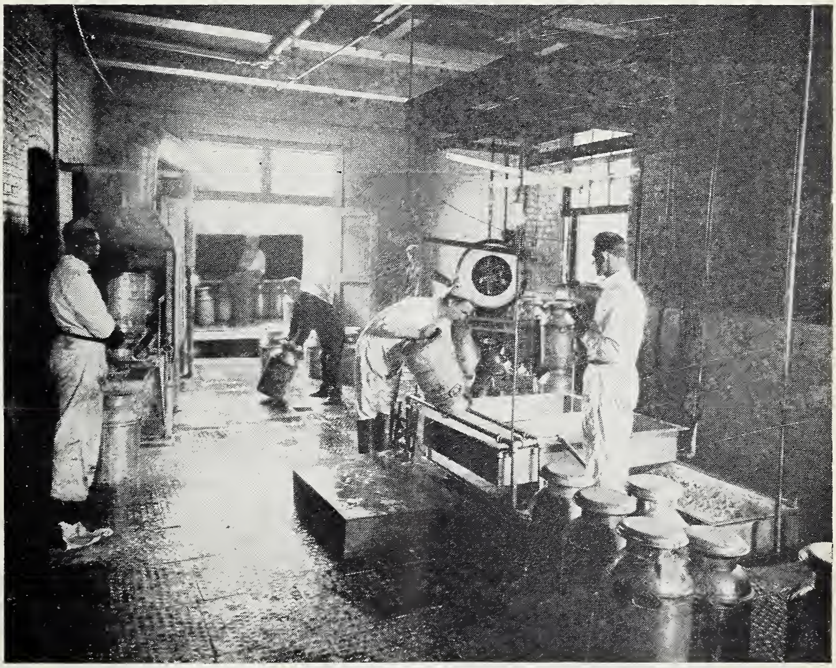

FIGURE 6.—Lack of a conveyor system at this plant necessitated extra labor in receiving the milk.

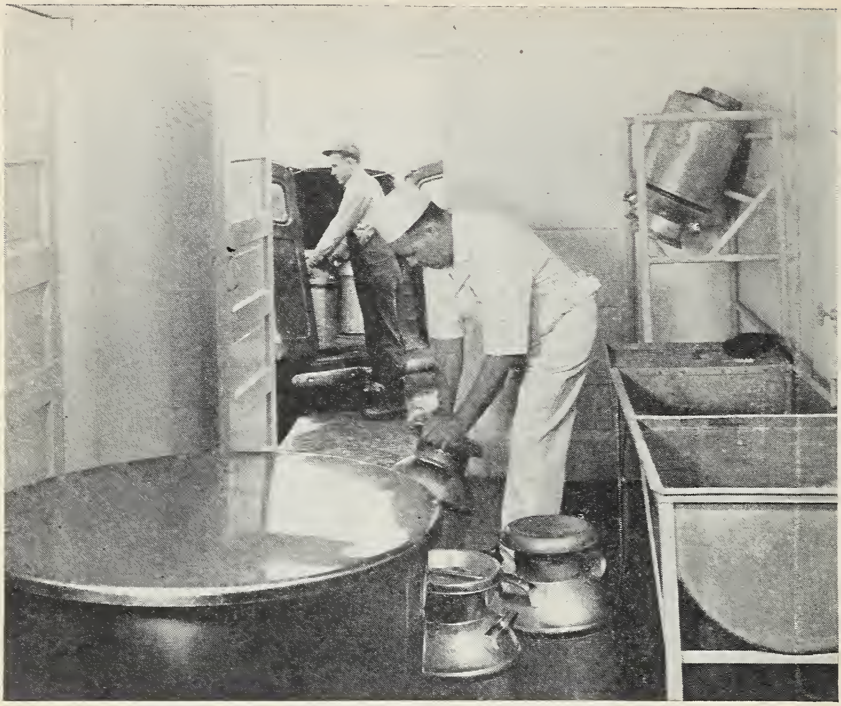

FIGURE 7.—In this plant, with the weigh can near the door a conveyor system is not necessary.

machine, with ample space for the workmen to get around the machine. As a rule, however, many of the bottles will have to be stored before being washed, and ample storage space should be provided. The conveyor should be so arranged that it will hold as many cases of empty bottles as possible, in order to eliminate labor in stacking cases.

The processing room should be sufficiently large to contain the milk vats, clarifier or filters, and pasteurizing equipment, and still leave plenty of room for the men to work and to get around the machines for the daily cleaning.

At small plants a conveyor system may not be necessary if the weigh can is placed close to the receiving-room door (fig. 7), so that the cans of milk may be dumped directly into the weigh can. After the cans are dumped, they are placed in the washer and then directly from the washer onto the trucks. While the milk is being received, some dirt is always carried into the building and numerous flies get in. The milk-receiving and can-washing room should therefore be screened and separated from the rest of the plant.

MILK-PROCESSING ROOM

At most plants tanks are required for storing the raw milk. These are usually located in the milk-processing room, although at some of the larger plants the storage tanks are in a separate room. From the storage tanks the milk is sent through a preheater and a filter, or a clarifier, and then to the pasteurizers and coolers. In the smaller plants storage tanks are not always necessary. The milk goes directly from the receiving tank through a filter or clarifier to vats which are used for storing, preheating, and pasteurizing the milk.

The milk-processing room should be separate from the rest of the plant and should be well lighted and ventilated. From the milk coolers the milk goes to the bottle fillers. While in some plants the bottle-filling equipment is in a separate room from the pasteurizing equipment, it is more often in the same room, especially at one-floor plants. If the pasteurizing equipment is on an upper floor, the filling equipment is usually in a separate room directly under it; but if the pasteurizing equipment is on a mezzanine floor, the two are in virtually the same room.

BOTTLE-WASHING ROOM

The bottle-washing room needs plenty of light and ventilation and it must be accessible to a street, alley, or driveway so that the returning empty bottles may be handled expeditiously. There should be ample space for the bottle-washing machinery and bottle conveyors, and for storage of the bottles.

MILK-STORAGE ROOM

A well-insulated milk-storage room (fig. 8) is necessary in order to store the milk at a low temperature from the time it is put into the bottles until it is sent out on the delivery trucks. The construction of the milk-storage room is discussed on page 8.

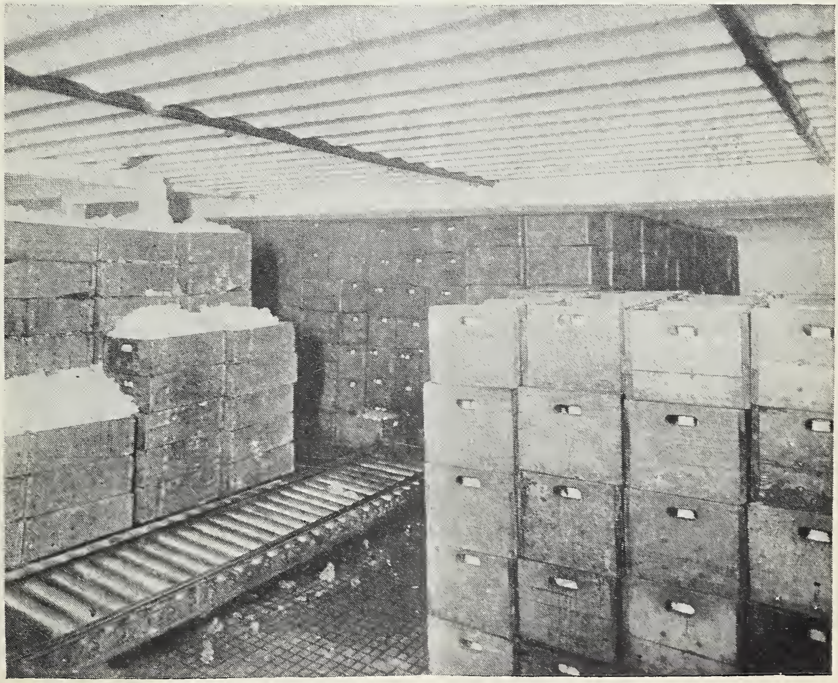

FIGURE 8.—A milk-storage room.

VISITORS' ROOM

Large plants generally have a special room for the entertainment of visitors. In this room lectures on the food value of milk, etc., may be given to visitors from time to time. Women's clubs and other organizations are often given the use of such rooms for their meetings. The room should preferably be connected with a balcony from which the operations in the plant can be viewed. The room should be attractive in appearance and well furnished with chairs, tables, etc. Such a room is considered a good investment for advertising purposes. In the construction of small plants, also, especially in the smaller communities, the advertising value of a visitors' room should be considered.

ROUTE SALESMEN'S ROOM

A room adjoining the office should be provided in which the route salesmen can score their books on returning from their routes. Bath and toilet facilities should also be provided for the route men and the employees in the plant.

LABORATORY

A well-lighted laboratory (fig. 9) for the bacteriological and chemical examination of milk is essential for all plants. Even the smaller plants should have a laboratory fully furnished with chemical and bacteriological equipment.

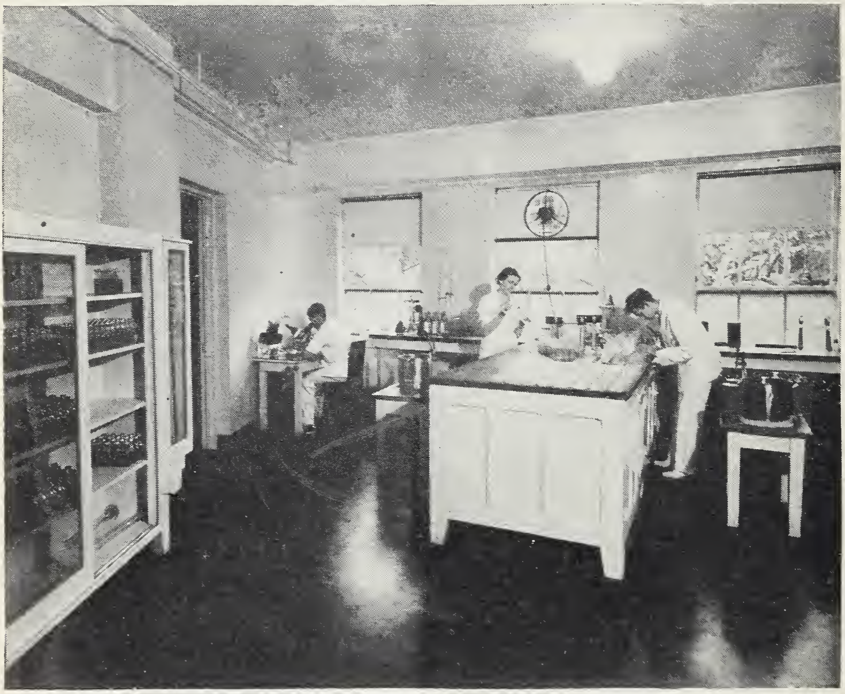

Figure 9.—Bacteriological laboratory in a milk plant.

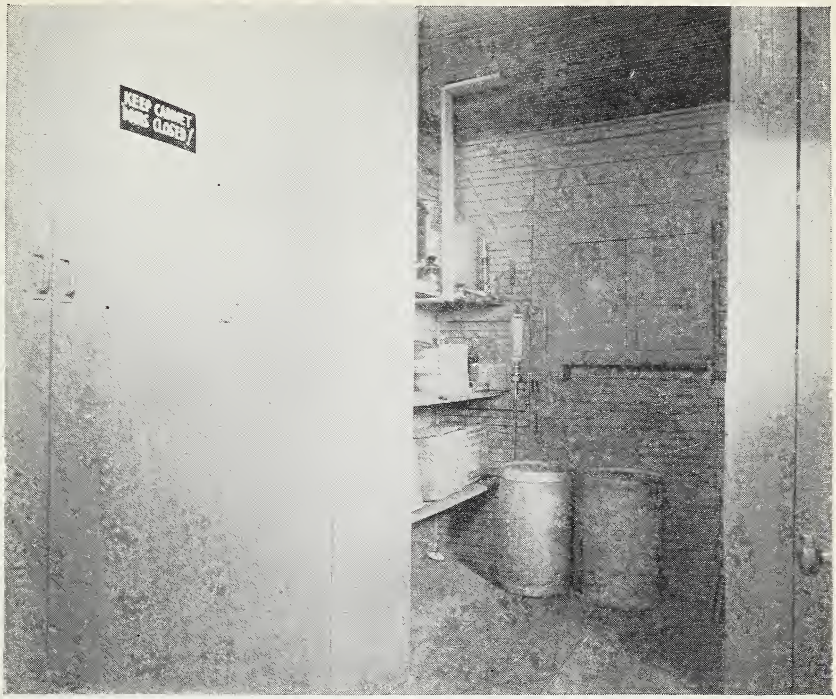

Figure 10.—Storage space for washing powders, bottle caps, replacement parts, etc.

BYPRODUCTS ROOM

Space should be provided for handling byproducts. Since small plants usually make only small quantities of butter, cottage cheese, and buttermilk, the work sometimes may be done in the milk-handling room. In medium-sized or large plants, however, one or more separate rooms are required for the byproducts department.

STORAGE ROOM

Milk plants of all sizes should have a place in which to store washing powders, bottle caps, replacement parts, etc. In the smaller plants cabinets in the byproducts room (fig. 10) may provide suitable storage. The larger plants should have a separate room for this purpose.

Plants that process large quantities of milk can save space in the processing room by using high-temperature short-time pasteurization (figs. 11 and 12). This system of pasteurization, however, is not recommended in plants that handle less than 10,000 to 12,000 pounds of milk daily. In planning a plant it should be remembered that even though the high-temperature short-time system is to be used in pasteurizing the milk, vats will be needed for pasteurizing cream and byproducts. Control officials in some localities have not approved high-temperature short-time pasteurization. Therefore, if its use is contemplated, the officials having jurisdiction in the municipality where the milk is to be sold should be consulted.

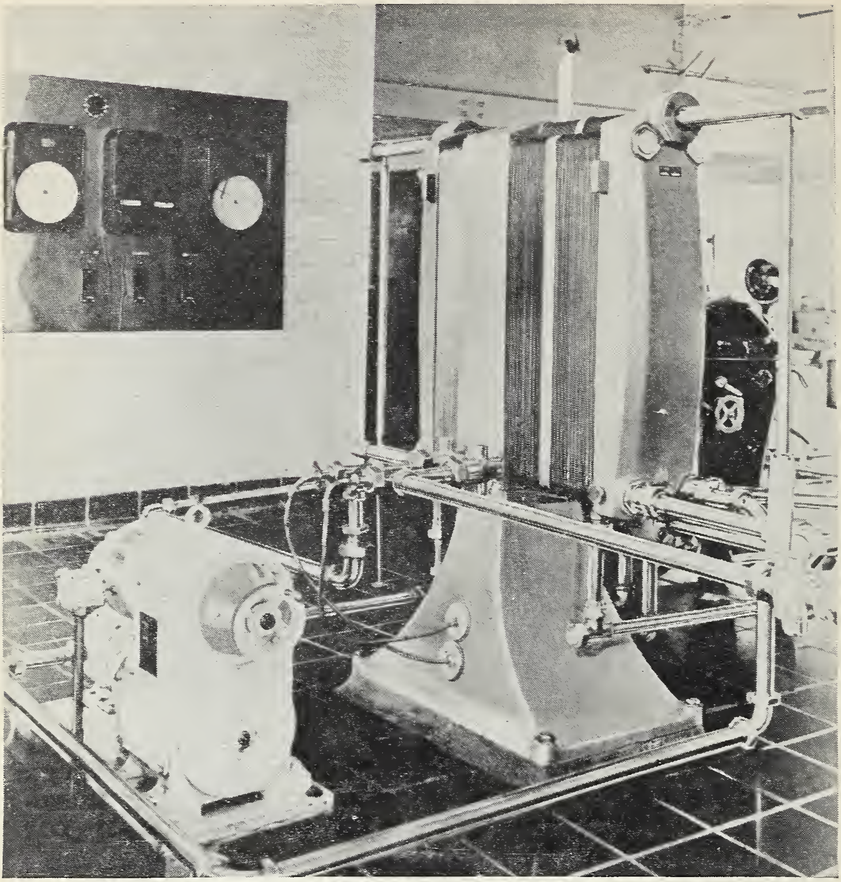

FIGURE 11.—High-temperature, short-time pasteurizer

The bottle-filling room, if it is to be separated from the pasteurizing room, may be smaller than the other rooms, because at most plants the bottles usually pass continuously through the bottle-filling room and are not stored there. There should be sufficient space to enable the men to get around the machines readily and keep the room clean and tidy at all times.

The milk-storage room should be large enough to hold all the milk that the plant can handle when running at full capacity, with some extra space for emergencies, and to allow for conveyors and for passageways between the stacks of various kinds of products. Too large a room, however, is wasteful and requires additional refrigeration. Space must be allowed for the cooling unit. Frequently the smaller plants use ice and the larger plants use refrigeration coils on the ceilings or walls. Unit coolers, however, are more satisfactory and are quite generally used in remodeling old plants and in new construction.

The most convenient height for stacking full bottle cases is six tiers for the quart-bottle cases and seven tiers for pint-bottle cases. When

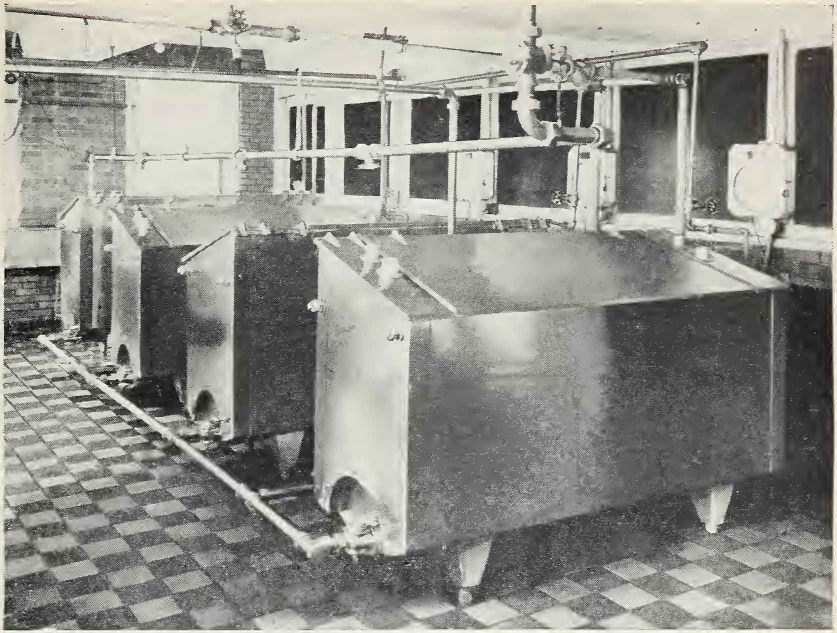

FIGURE 12.—Batch pasteurizers.

cases of quart bottles are piled six tiers high and pint bottles seven tiers high, about 2,000 gallons of bottled milk in cases can be stacked in an area of 15 by 16 feet, or 240 square feet, exclusive of space for conveyors, etc. Allowing space for the men to work and for emergencies, a room about 18 by 20 feet would be needed for storing this quantity of milk. A room 12 by 15 feet in size would provide storage space for about 1,000 gallons of bottled milk. The above figures are based on the use of round bottles. Nearly 50 percent more milk can be stored on a given floor area if square bottles are used instead of round bottles.

The size of room needed at any individual plant will of course depend on the proportion of milk that is held over in storage. At many of the larger plants, much of the milk is sent to delivery trucks or to branch trucks direct from the bottling department, without being stored in the milk-storage room. If large quantities of milk are stored there in cans, more space is required, as it is usually not feasible to deck the cans more than two tiers high.

The following are the approximate sizes of milk-storage rooms required for plants handling various quantities of bottled milk:

Quantity of bottled milk handled (gallons)	*Approximate size of milk-storage room (feet)*
300	8 by 8
500	10 by 10
1, 000	12 by 15
2, 000	18 by 20
4, 000	24 by 30

Table 2 shows the area of the principal rooms at several well-arranged plants of different capacities.

TABLE 2.—*Area of principal rooms in 11 representative milk plants of various capacities*

Plant No.	Milk and cream		Receiving milk and washing cans						Handling bottles					
	Handled daily	Bottled	Receiving room		Can-washing room		Total	Per 100 gallons handled daily	Dirty-bottle storage		Bottle-washing room		Total	Per 100 gallons handled daily
			Size	Per 100 gallons handled daily	Size	Per 100 gallons handled daily			Size	Per 100 gallons handled daily	Size	Per 100 gallons handled daily		
	Gallons	*Percent*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*
1	800	93	350	43. 8			350	43. 8			900	112. 5	900	112. 5
2	1, 500	95	(1)		(1)		(1)				700	46. 6	700	46. 6
3	3, 000	90					900	30. 0					1, 800	60. 0
4	3, 800	98	252	6. 6	266	7. 0	518	13. 6	560	14. 7	1, 110	29. 2	1, 670	43. 9
5	4, 000	95	460	11. 5			460	11. 5					2, 430	60. 8
6	6, 000	94					1, 200	20. 0					2, 630	43. 8
7	7, 500	96	228	3. 0	418	5. 6	646	8. 6	543	7. 2	993	13. 2	1, 536	20. 5
8	9, 000	72					810	9. 0			2, 100	23. 3	2, 100	23. 3
9	9, 800	90					1, 125	11. 5	4, 800	49. 0	2, 700	27. 6	7, 500	76. 5
10	20, 000	97	1, 512	7. 6	3, 290	16. 4	4, 802	24. 0			7, 504	37. 5	7, 504	37. 5
11	35, 000	94					4, 800	13. 7	3, 600	10. 3	3, 200	9. 1	6, 800	19. 4

Plant No.	Handling milk										Milk-storage room		Total area of important rooms	
	Raw-milk storage, pasteurizing and cooling						Bottling room		Total	Per 100 gallons handled daily	Size	Per 100 gallons handled daily	Total	Per 100 gallons handled daily
	Raw-milk storage		Pasteurizing and cooling		Total	Per 100 gallons handled daily	Size	Per 100 gallons handled daily						
	Size	Per 100 gallons handled daily	Size	Per 100 gallons handled daily										
	Sq. ft.	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*
1			500	62. 5	500	62. 5	300	37. 5	800	100. 0	400	50. 0	2, 450	306. 2
2			550	36. 7	550	36. 7	375	25. 0	925	61. 7	550	36. 7	2, 175	145. 0
3			1, 300	43. 3	1, 300	43. 3	1, 200	40. 0	2, 500	83. 3	1, 200	40. 0	6, 400	213. 3
4			744	19. 6	744	19. 6	320	8. 4	1, 064	28. 0	690	18. 2	3, 942	103. 7
6			540	13. 5	540	13. 5	700	17. 5	1, 240	31. 0	1, 426	35. 7	5, 556	138. 9
6			720	12. 0	720	12. 0	720	12. 0	1, 440	24. 0	1, 110	18. 5	6, 380	106. 3
7	979	13. 1	885	11. 8	1, 864	24. 9	318	4. 2	2, 182	29. 1	1, 760	23. 5	6, 124	81. 6
8					1, 600	17. 8	1, 000	11. 1	2, 600	28. 9	1, 680	18. 7	7, 190	79. 9
9	650	6. 6	1, 500	15. 3	2, 150	21. 9	840	8. 6	2, 990	30. 5	1, 250	12. 8	12, 865	131. 3
10	810	4. 1	2, 790	14. 0	3, 600	18. 0	1, 587	7. 9	5, 187	25. 9	3, 848	19. 2	21, 341	106. 7
11	2, 200	6. 3	1, 840	5. 3	4, 040	11. 5	800	2. 3	4, 840	13. 8	4, 000	11. 4	20, 440	58. 4

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[1] No separate receiving room at this plant.

Checking in the Routes

The plant should be so arranged that the returned bottles can be checked in rapidly and with as little cost for labor as possible. For large plants, a system of conveyors leading from the checking-in platform directly to the washers is usually the most economical way to save both time and labor in unloading and checking in the bottles. The amount of labor required for washing bottles also depends to a considerable extent on the system used in checking in. More bottles will have to be sorted at some plants than at others, depending on how they come in from the routes; but at the average plant more bottles are checked in and washed per man-hour where they are checked in on conveyors which lead directly to the bottle washers than where they are checked in, stacked, and later transferred to the washers from the bottle-receiving platform or bottle-storage department by conveyors or trucks. At plants using the latter system, the best results will be obtained if the transferring and stacking operations are so synchronized that stacking will be kept to a minimum.

At small plants a transfer system between the checking-in platform and the bottle washer may not be necessary. At such plants the bottle washer may be located at a point close to the checking-in platform so that the bottles can be fed directly into the washer.

Checking Out the Routes

The plant arrangement for checking out the routes will depend on the number of routes to be checked out. It is desirable that the plant be so laid out that all the routes can be checked out in at least 3 or 4 hours and in some cases 2 hours is all that can be devoted to this operation. In order to be able to check out a large number of routes in a short time, it is necessary to load out from several different points at the same time.

At some large plants, the delivery trucks are loaded from four or more doors direct from the milk-storage room, while at others several trailers are lined up and the trucks are loaded directly from them. When trailers are used, they are loaded at the main bottling plant and then are usually spotted at the distributing branches. Usually quarts of milk will be delivered to the route driver from one trailer, pints from another, cream from another, and so on; so that delivery trucks travel in a direct line from one trailer to the next. Likewise, when checking out from several doors direct from the milk-storage room, the driver will get one class of goods at each door, although in some cases the goods are so arranged in the milk-storage room that an entire load is put out at each door.

Often, when different classes of goods are put out at the various doors, a definite number of quarts of milk are delivered to each driver from the first door, and the remainder of his quarts as well as his cream and other products are delivered at the other doors. In this way, the checker at the first door does not need to know what the load sheet calls for, as he gives each driver a basic number of quarts, as, for example, 15 cases or 20 cases, depending on how large loads are carried, and the driver completes his requirement for quarts of milk at one of the other doors.

At plants which have a small number of routes to check out, it is neither necessary nor desirable to have so many loading points—one or two doors direct from the storage room may be enough (fig. 13). At very small plants, the routes may be checked out by trucking the milk from the milk-storage room to the loading-out platform. In fact, plants with five to ten routes can check out the routes fully as economically, so far as labor is concerned, by using hand trucks to transfer the milk to the loading-out platform.

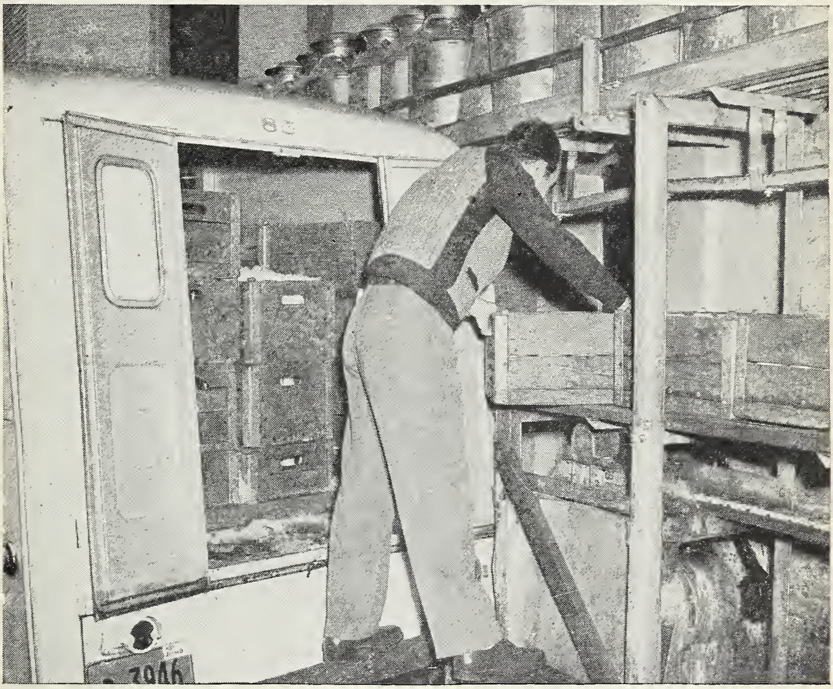

FIGURE 13.—Loading a delivery truck at a plant where the routes are checked out on a conveyor from the milk-storage room.

Table 3 shows a comparison of the results obtained in a study made some years ago by the Bureau of Dairy Industry of different systems of checking out routes.

TABLE 3.—*Comparison of different systems of checking out routes as to labor and time required*

Group	System used	Plants	Routes			Men employed	Hours[1]
			Wholesale	Retail	Total		
		Number	*Number*	*Number*	*Number*	*Number*	*Number*
1	One chute direct to delivery truck	19	1. 7	23. 5	25. 2	1. 9	2. 5
2	Barrel or warehouse trucks	6	13. 8	40. 8	54. 7	6. 0	5. 0
3	Two chutes to delivery truck	24	4. 1	44. 2	48. 3	2. 9	3. 6
4	Wheel platform and dolly trucks	6	6. 7	45. 3	52. 0	3. 5	3. 6
5	Lift trucks	7	. 3	33. 1	33. 4	5. 7	1. 9
6	Three chutes to delivery truck	14	2. 1	77. 9	79. 9	6. 4	2. 6
7	Four or more chutes to delivery truck	10	9. 1	119. 9	129. 0	8. 2	3. 1
8	Loading from seven or more points	7	2. 1	157. 3	159. 4	13. 6	3. 0

Group	System used	Man-hours[2]	Routes per hour[1]	Routes per man-hour[2]		Time required per route	
		Number	*Number*	*Number*[3]	*Number*[4]	*Minutes*[3]	*Minutes*[4]
1	One chute direct to delivery truck	4. 9	10. 0	5. 1	5. 1	6. 0	6. 9
2	Barrel or warehouse trucks	32. 8	10. 9	1. 7	1. 8	5. 5	5. 7
3	Two chutes to delivery truck	11. 4	13. 6	4. 2	4. 5	4. 4	4. 8
4	Wheel platform and dolly trucks	16. 8	14. 5	3. 1	3. 8	4. 1	8. 7
5	Lift trucks	16. 6	18. 0	2. 0	3. 1	3. 3	3. 6
6	Three chutes to delivery truck	19. 1	30. 7	4. 2	4. 7	2. 0	2. 0
7	Four or more chutes to delivery truck	29. 0	42. 3	4. 4	4. 9	1. 4	1. 5
8	Loading from seven or more points	40. 5	53. 8	3. 9	4. 0	1. 1	1. 1

[1] Man-hours required for putting up orders is not considered.
[2] Man-hours required for putting up orders is included.
[3] Weighted average.
[4] Average of averages.

EFFECT OF PLANT ARRANGEMENT ON BREAKAGE OF BOTTLES

The number of bottles broken in milk plants depends to a large degree on the arrangement of the plant. The breakage is usually greater in plants where the bottles are transferred between floors than in plants where all operations are performed on one floor. Other points in relation to breakage of bottles that should be kept in mind in laying out the plant are as follows:

Where bottles are transferred long distances, less breakage results if power-controlled conveyors are used than if gravity conveyors without controls are used. However, if gravity conveyors are equipped with stops automatically controlled by electric switches, the breakage may be kept as low as where power conveyors are used. When the gravity conveyor becomes full, the switch will automatically shut off the "booster" that brings up the cases of bottles on to the conveyor, and thus prevent any forcing or jamming of the cases on the conveyor. In plants where bottles are elevated to the second floor to be washed, the breakage is generally greater than in plants where they are washed on the first floor or in the basement, provided, in the latter case, that they are elevated, after being washed, to the first floor by the washer itself.

The best results in preventing breakage of empty bottles are obtained by having the checking-in platform and the bottle-washing room so arranged in relation to each other that the bottles can travel to the washers on conveyors with a minimum of rehandling and stacking.

The breakage is greater with the indirect system of washing and filling bottles than with the direct system, principally because of the extra handling involved. (By direct system is meant a system in which the bottles go directly from the washers to the fillers without any intervening stacking.)

EFFECT OF TRANSFERRING BOTTLES BETWEEN FLOORS

A study of the effect of transferring bottles between floors was made several years ago by the Bureau of Dairy Industry. The results, as reported in table 4, show the number of bottles filled daily and the breakage at 92 plants classified according to the number of transfers of bottles from one floor to another by conveyor, elevator, chute, or other equipment. Delivery of washed bottles to a higher floor by the bottle washer itself was not considered as a transfer. For example, if the bottles were sent from the first floor to the basement to be washed and the washer itself elevated them to the first floor to be filled, with no further transfer between floors, this was regarded as one transfer.

TABLE 4.—*Effect on bottle breakage of number of times bottles are transferred from floor to floor*

Transfers of bottles	Plants	Bottles filled daily	Glass broken per 1,000 bottles filled		
			Before washing	At discharge end of washers and at fillers	Total plant breakage
	Number	*Number*	*Pounds*	*Pounds*	*Pounds*
None	64	38, 469	4. 9	5. 8	11. 8
1	10	56, 504	4. 3	6. 3	12. 3
2	16	82, 775	6. 0	7. 4	15. 3
3	2	25, 915	9. 3	15. 4	27. 1

According to this study the breakage increased with the number of transfers. At the plants which carried on all the operations on one floor, the total breakage per plant averaged only 11.8 pounds of glass per 1,000 bottles filled, whereas at the plants making 1, 2, and 3 transfers it was 12.3, 15.3, and 27.1 pounds, respectively.

While transferring bottles two or three times does not necessarily result in excessively high breakage, provided the conveyors and other equipment are of proper design and are kept in good repair, these data indicate that, at the average plant, the breakage is considerably greater where the bottles are transferred two or three times than where all the operations are performed on one floor, or where the bottles are sent to the basement to be washed and are elevated to the first floor by the washer itself, with no further transfers.

Effect of Size, Arrangement, and Type of Plant on Total Labor Requirements

The number of employees required to carry on the various operations in a milk plant depends to a large degree on the lay-out and size of rooms, arrangement of machinery, and size and type of building. The number of men employed at different plants of similar capacity varies widely. Some plants employ six times as many men as other plants of about the same size. Although other factors are involved, such as the relative number of bottles of milk handled, it is evident that some plants are operated more inefficiently than others because of faulty lay-out and arrangement of rooms and machinery. Many plants could cut down their labor requirements by a more economical lay-out of machinery and equipment, while others could reduce it by installing more labor-saving machinery. Some plants have too many floors or stories to be able to utilize labor efficiently. For example, it is often necessary to have a number of men and a foreman for each floor.

In a study of the labor employed in 92 milk plants of various sizes, made by the Bureau of Dairy Industry several years ago, the results were grouped according to size of plant and the number of stories in each plant. (See table 5.)

Table 5 shows that the average number of persons employed per plant for each group is considerably lower, for plants of the same average capacity, in the one-story plants than in the two-story plants, and is much higher in the plants of three or more stories than in the two-story plants. It follows that the average efficiency of the plant workmen, measured in quantity of milk and cream handled per plant employee, is higher in plants of the one-story type; even the smaller one-story plants comparing favorably with larger and better equipped plants of more than one story.

From this survey the best results, with respect to labor requirement, are evidently obtained in plants where the bottle washing and filling departments and the milk-storage room are all on the first floor. In this way a minimum of handling and of supervision is required. In plants where the bottles are washed in the basement and the bottle washer delivers the bottles to the fillers on the first floor, nearly as good results are obtained.

TABLE 5.—*Effect of type of building and size of plant on labor requirements at 92 milk plants*

Group No.	Plants	Milk and cream handled per plant			Employees[1]	Milk and cream handled per employee		
		Quantity	Average	Bottled		Total	Bottled	Exclusive of checkers[2]
	Number	*Gallons*	*Gallons*	*Percent*	*Number*	*Gallons*	*Gallons*	*Gallons*
		PLANTS HAVING ONE STORY						
1	5	2,000 or less	1,314	83.7	5.8	227	190	263
2	10	2,001 to 5,000	3,152	88.9	11.0	287	255	341
3	6	5,001 to 10,000	7,570	90.1	26.2	289	261	361
4	2	10,001 to 15,000	10,975	84.5	30.0	366	309	422
5	------	15,001 to 20,000	------	------	------	------	------	------
6	1	Over 20,000	21,000	82.0	67.0	313	257	344
		PLANTS HAVING TWO STORIES						
1	8	2,000 or less	1,466	79.6	7.4	199	158	228
2	11	2,001 to 5,000	3,631	85.7	19.0	189	164	220
3	23	5,001 to 10,000	7,103	84.9	34.4	206	175	252
4	6	10,001 to 15,000	11,742	80.6	52.5	224	180	263
5	4	15,001 to 20,000	16,875	83.7	57.3	295	247	343
6	3	Over 20,000	25,261	88.1	102.6	246	217	277
		PLANTS HAVING THREE OR MORE STORIES						
1	------	2,000 or less	------	------	------	------	------	------
2	------	2,001 to 5,000	------	------	------	------	------	------
3	5	5,001 to 10,000	8,169	82.7	45.0	182	150	235
4	1	10,001 to 15,000	11,150	88.0	41.0	272	239	372
5	4	15,000 to 20,000	17,910	89.3	100.0	179	160	220
6	3	Over 20,000	31,783	89.3	115.3	276	246	327
		ALL PLANTS						
1	13	2,000 or less	1,407	81.0	6.8	208	169	------
2	21	2,001 to 5,000	3,308	88.2	15.3	216	194	------
3	34	5,001 to 10,000	7,342	85.1	34.5	213	181	------
4	9	10,001 to 15,000	11,504	82.0	46.0	249	205	------
5	8	15,001 to 20,000	17,393	87.0	78.6	221	192	------
6	7	Over 20,000	27,448	88.0	103.0	267	235	------

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[1] Including all men whose time was chargeable to the market-milk department. If they were used in other departments also, time was prorated. Clerks and bookkeepers were not included.

[2] At some plants the checkers are not included with the plant employees but with the delivery or sales employees.

MISCELLANEOUS REQUIREMENTS

Good ventilation is essential in a milk plant, in order to get rid of moisture and bad air and bring in an ample supply of pure air. Even small plants should be equipped with fans and ventilators, since natural ventilation cannot be relied upon.

All windows and doors should be screened during the fly season. Window screens should be on the outside of the casing, and screen doors should open outward. The receiving room, especially, should be well screened, and all doors through which workmen pass continually should have self-closing devices. Revolving fans placed near doors and blowing toward them will keep many flies from entering the plant and also force flies out as the doors are opened.

In addition to the general toilet facilities in the plant, there should be a washbowl, with soap and towels handy, in the milk-handling room (fig. 14). Employees in the handling room often get their hands dirty from setting up machinery, handling bottles, cases, etc., and should have a convenient place to wash before handling clean bottles or milk.

All milk apparatus, especially vats, coolers, and bottling machines, should be kept covered so the milk will not be exposed to the air (fig. 15).

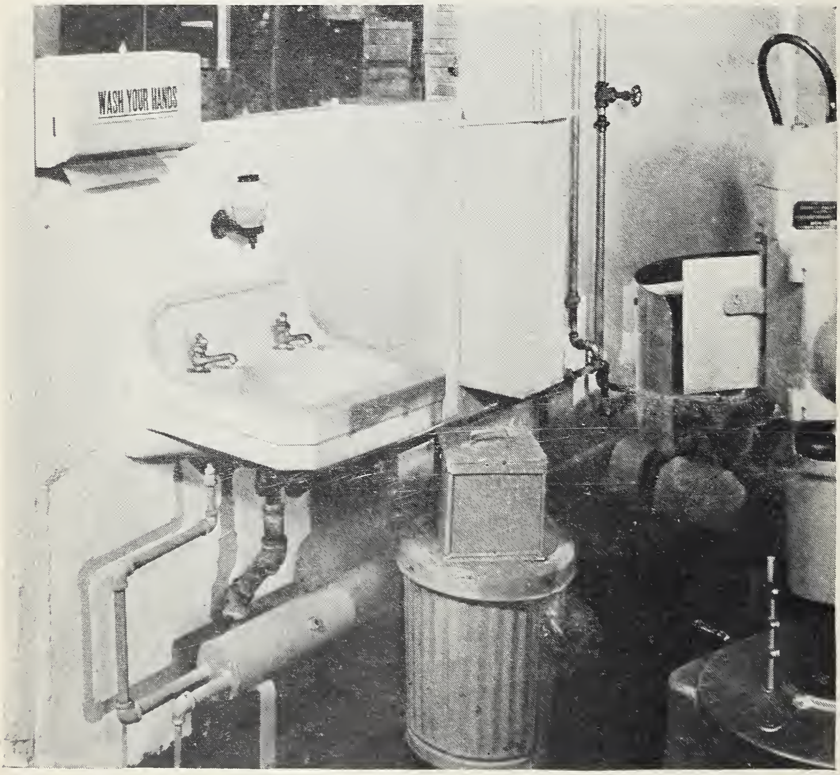

FIGURE 14.—Washbowl with soap, towels, and trash can. In the background can be seen a small cabinet for storing bottle caps and hoods and a part of the hooding machine.

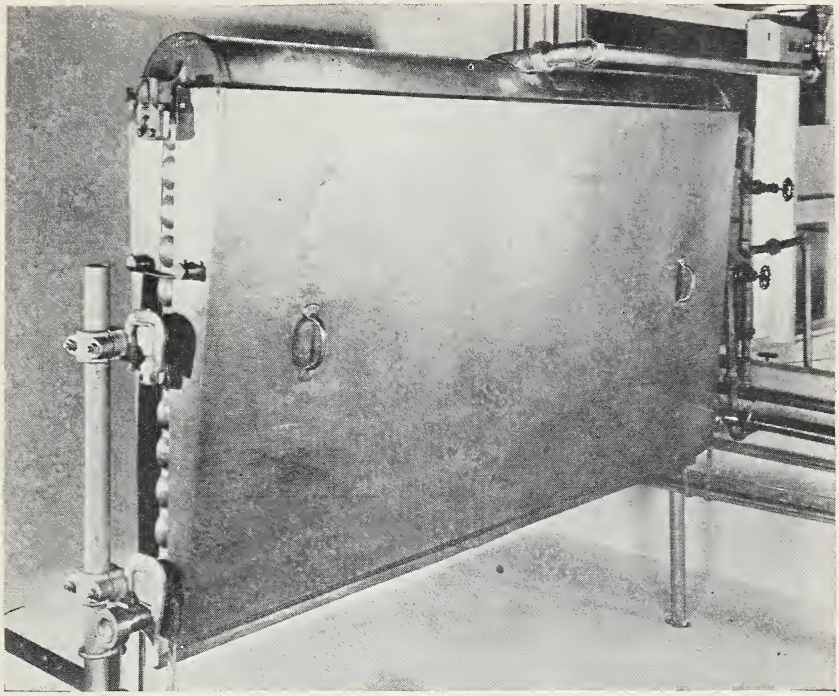

FIGURE 15.—A properly covered milk cooler.

FLOOR PLANS[4]

A number of floor plans worked out by the Bureau of Dairy Industry are presented in the following pages as suggestions and guides for designing milk plants of various sizes. Although the prospective builder may not desire to arrange his plant exactly according to any of these plans, he may find them helpful in designing a plan for his particular set of conditions. The arrangement and lay-out will depend largely on the equipment he selects and on the building site available. Before starting the building operations, it is advisable to discuss the prospective plan with local control officials, in order to be certain that it complies with both the State and local ordinances and regulations.

In designing the floor plans an effort was made to have the plants large enough to allow plenty of working room, easy access to all sides of the equipment for cleaning purposes, and to avoid having any waste space. An effort was made also to arrange the rooms and equipment so that the milk would follow a short and direct route through the plant. This objective was accomplished by placing the milk-receiving vat immediately contiguous to the pasteurizer, the pasteurizer close to the bottle filler, and the bottle filler convenient to the cold-storage room.

Milk may flow through a small plant by any of the three routes shown in figure 16. The line of flow may be straight, it may involve a 90-degree angle, or it may make a U-turn.

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[4] F. P. Hanrahan, dairy engineer of the Bureau of Dairy Industry, gave valuable suggestions and assistance in designing the floor plans shown in this circular.

The flow through larger plants becomes more complex. More equipment and different placements of equipment are necessary, but they do not materially alter the directional flow. The milk may flow from the receiving vat through a clarifier, over a cooler, and into a storage tank. From the storage tank it may pass through a preheater directly to the pasteurizer, or from the preheater it may pass through a homogenizer before going to the pasteurizer. The position of the clarifier varies in different plants and may be found at any place in the line leading to the pasteurizer. In the large plants, branch-line flows are also necessary so that the milk may flow from the storage tank directly to the byproducts room or from the preheater to a cream separator. From the separator the cream either flows to the pasteurizer, cooler, bottler, and then to the cold-storage room or to the byproducts room and then to the cold-storage room. The skim milk usually flows from the separator to the byproducts room.

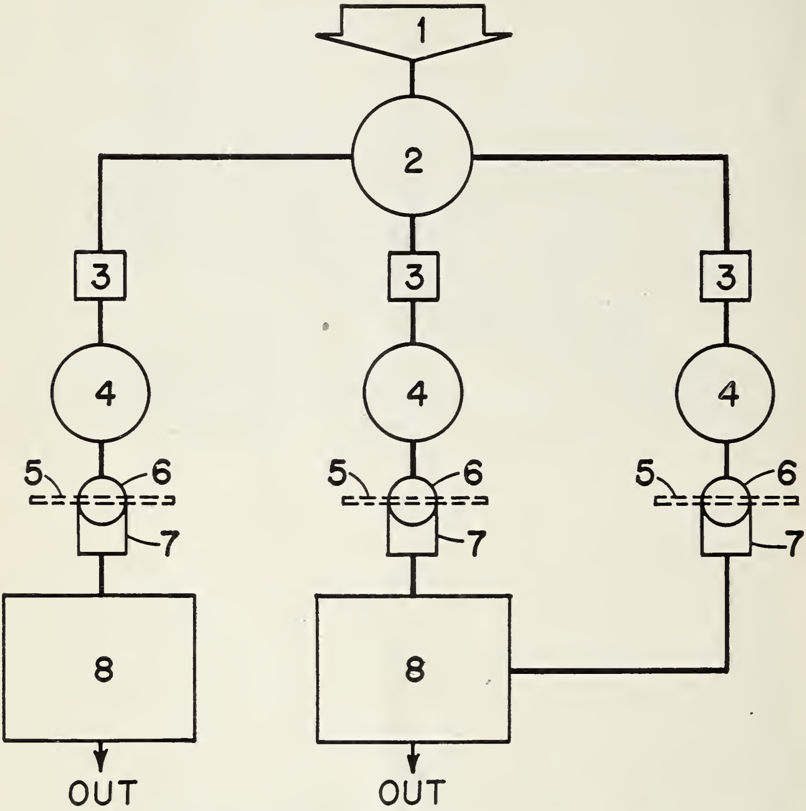

FIGURE 16.—Diagrammatic flow of milk through a small milk plant: (1) Scale and weigh tank; (2) receiving vat; (3) clarifier, or filter; (4) pasteurizer; (5) cooler; (6) filler; (7) capper; (8) cold storage.

A Plant of 100 to 200 Gallons Daily Capacity

Figure 17 shows a floor plan of a plant designed to pasteurize and bottle from 100 to 200 gallons of milk daily. A plant of this size should be as simple as possible in construction and arrangement. As the business grows and more room is required, the plant could be enlarged by moving the end wall outward. The plan shown includes a laboratory, but if the owner prefers to employ the service of a commercial laboratory this plan could be shortened by 8 feet. A 100-gallon batch pasteurizer is indicated in the plan. There is, however, sufficient floor space for an additional vat of this capacity, or a 200-gallon vat may be used. The pasteurizing and bottling equipment is concentrated in a small space so that one man can take care of both conveniently, the lines of sanitary piping are short, and the pasteurizer is close to the dump tank.

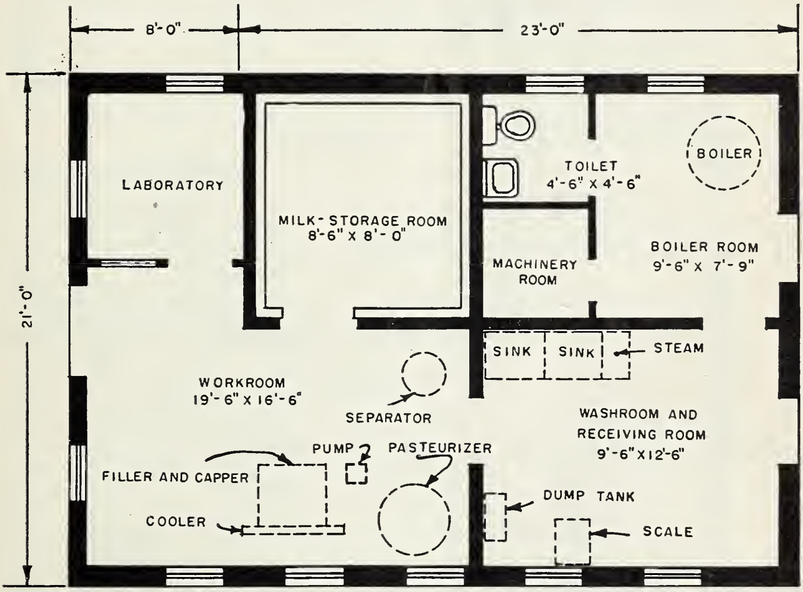

Figure 17.—Plan for a milk plant of 100 to 200 gallons daily capacity.

For a plant of this capacity, either dolly or platform trucks may be used for handling the bottles both before and after filling. As soon as the bottles are steamed or treated with a chlorine solution, they may be loaded on platform trucks. The loaded trucks may be placed near the bottle filler, and after the bottles are filled they may be replaced in the cases and again loaded on the truck and put into cold storage. Trucks may also be used in loading out. By this system 1 man can move from 6 to 18 cases at a time with great savings of time and labor, as compared with the system of carrying each case separately.

A PLANT OF 250 TO 500 GALLONS DAILY CAPACITY

A floor plan for a conveniently arranged plant of 250 to 500 gallons daily capacity is shown in figure 18. This plant is designed to be accessible from all sides. The loading out may be done directly through an opening from the milk-storage room to the outside of the plant, but if this side of the plant is not accessible for such loading out it may be accomplished indirectly through the bottling room and washroom to the door on the opposite side of the plant. With the first system a chute or roller conveyor could be used, whereas the second system would require platform trucks or dollies.

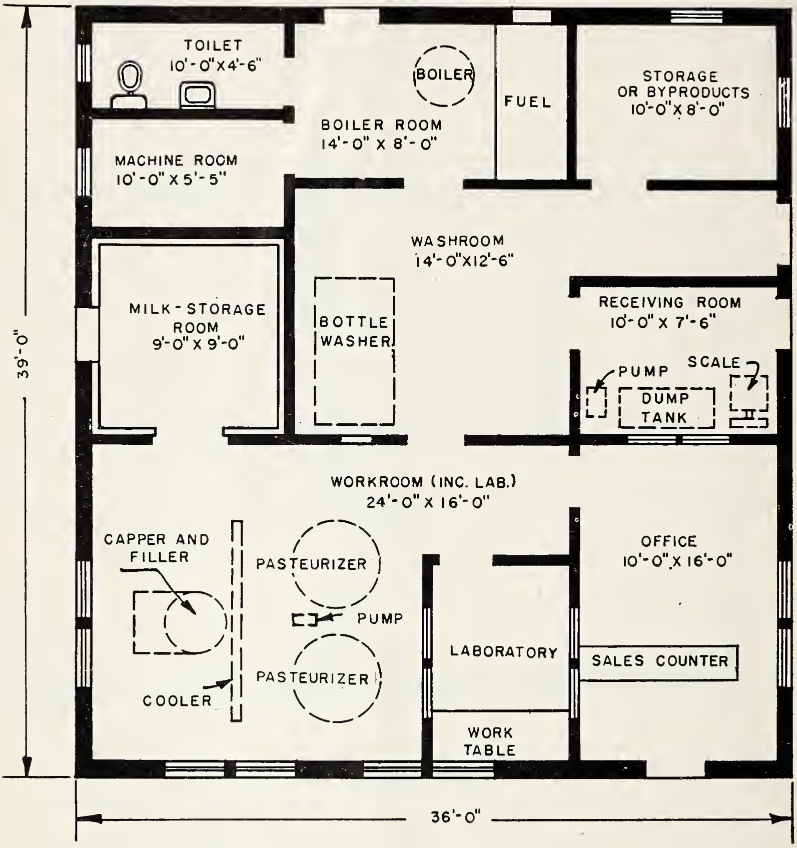

FIGURE 18.—Plan for a milk plant of 250 to 500 gallons daily capacity.

The laboratory and the pasteurizing and bottling equipment are in the front of the building, where they may serve to attract attention. Scales are shown in the receiving room, indicating that the milk is to be weighed in the cans. A weigh-can would be more desirable, however, and one could be added at a slight additional cost.

Two 250-gallon pasteurizers are shown in the plan, but only one would have to be installed unless the plant was handling 500 or more gallons of milk daily. The capacity of the plant can be further increased by extending the workroom and the cold room.

A PLANT OF 600 TO 900 GALLONS DAILY CAPACITY

Figure 19 shows a floor plan for a plant designed to pasteurize and bottle from 600 to 900 gallons of milk daily. This plan is similar to the one shown in figure 17 but contains more floor space. This plant may be built with entrances on only two sides if necessary.

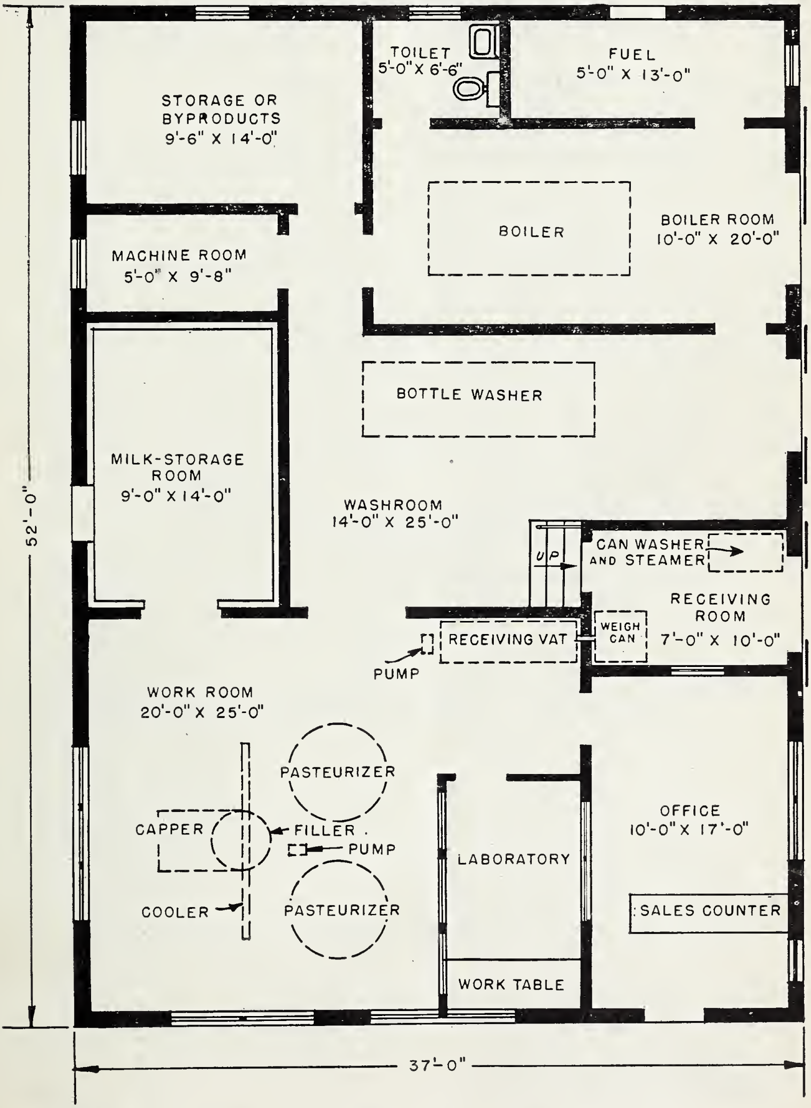

FIGURE 19.—Plan for a milk plant of 600 to 900 gallons daily capacity.

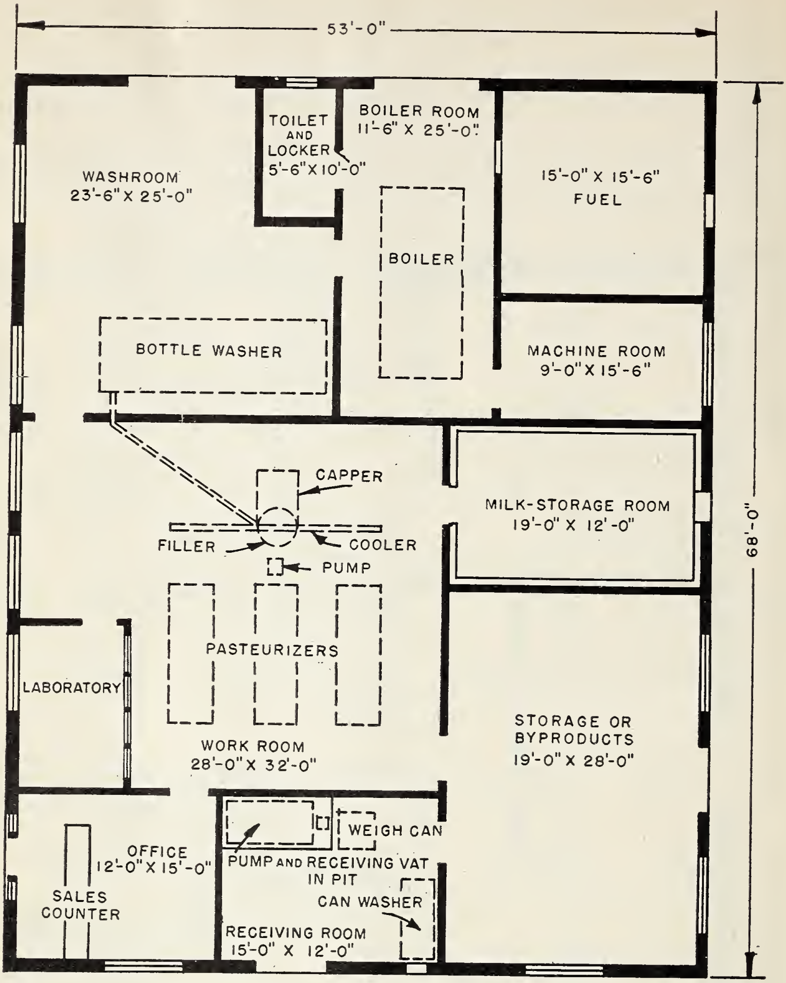
53'-0"
68'-0"
TOILET AND LOCKER 5'-6" X 10'-0"
BOILER ROOM 11'-6" X 25'-0"
WASHROOM 23'-6" X 25'-0"
15'-0" X 15'-6" FUEL
BOILER
BOTTLE WASHER
MACHINE ROOM 9'-0" X 15'-6"
CAPPER
MILK-STORAGE ROOM 19'-0" X 12'-0"
FILLER
COOLER
PUMP
PASTEURIZERS
LABORATORY
WORK ROOM 28'-0" X 32'-0"
STORAGE OR BYPRODUCTS 19'-0" X 28'-0"
WEIGH CAN
OFFICE 12'-0" X 15'-0"
PUMP AND RECEIVING VAT IN PIT
SALES COUNTER
CAN WASHER
RECEIVING ROOM 15'-0" X 12'-0"

FIGURE 20.—Plan for a milk plant of 900 to 1,200 gallons daily capacity.

The receiving-room floor is about 4 feet above the main floor, which makes it easier to unload and load cans and permits a gravity flow from the weigh can to the receiving vat. The receiving vat is placed in one corner of the pasteurizing or workroom. This shortens the length of sanitary pipe needed between the vat and the pasteurizer and puts the vat where it can be cleaned easily and where the man in charge of pasteurizing can keep his eye on the quantity of milk in the vat.

The plan indicates the use of two 300-gallon vats. There is sufficient space in the workroom to permit installation of another vat of this capacity, or the capacity can be further increased by extending the workroom and cold room.

A Plant of 900 to 1,200 Gallons Daily Capacity

The floor plan shown in figure 20 is for a plant pasteurizing and bottling from 900 to 1,200 gallons of milk daily. It requires a lot with access to the building on three sides.

The plan indicates the use of three pasteurizing vats each having a capacity of 300 gallons. In the washroom there is a small soaker type "comeback" bottle washer. Since this washer delivers the individual bottles directly to the filler no storage space is needed for clean bottles. This permits the washer to be placed close to the wall, and all space between the washer and the outside door is thus available for storing dirty bottles.

If the receiving vat is placed in a pit, as indicated in the plan, the pit must be large enough to allow workmen to get at all sides of the vat to clean it. An alternate plan would be to raise the receiving room, as in figure 19, and place the receiving vat on the main-floor level.

Those who desire to erect a larger plant than that shown in figure 20 should consult a dairy engineer. This plant, however, may be at least doubled in capacity by raising the roof over the front part of the building and constructing a mezzanine over the storage rooms. The pasteurizing equipment, either vats or a short-time high-temperature pasteurizer, and storage tanks for the incoming milk, would then be placed on the mezzanine. The bottle filler and capper would be left on the first floor, and the milk-storage room would be increased in size by including a part of the byproducts room.

SUMMARY

Conditions should be thoroughly investigated and found to be favorable before the establishment of a milk plant is attempted.

For large plants the assistance of a competent architect in making plans is required. Plans for a small plant can often be drawn without such aid.

Favorable location of the plant is important. Among the factors to be considered are: Convenience of getting the raw supply to the plant, proximity to distribution area, advertising possibilities, and ample space to afford an efficient arrangement of the plant.

The plant should be so arranged that provision may be made for enlarging it when necessary, without interfering with the convenient arrangement of the rooms and apparatus.

The number of stories in plants varies from one to four or more, but the majority of modern plants are usually of only one or two stories.

Up-to-date plants are usually constructed of brick, concrete, or hollow tile, finished on the inside with smooth cement.

Inside walls should have a smooth finish. Tile or enamel brick are desirable for the bottling and pasteurizing rooms.

Concrete or tile floors are desirable in all milk plants. Tile floors add to the appearance of the plant.

Floors must be well drained and have proper connection with the sewer.

There are several methods of handling milk in the plant. It may be handled by gravity, by pump, or by various combinations of gravity and pump. In many modern plants all the operations of milk handling are on the first floor. Comparatively few plants now use the gravity system of handling milk.

Plants may also be classified on the basis of the course of the bottles through the plant. The most common and also the most desirable system is to have all the bottle-washing and filling operations on the first floor.

In a well-arranged plant with power-controlled conveyors there will be less bottle breakage than in a poorly arranged plant. The transferring of bottles from one floor to another tends to cause excessive breakage of bottles.

In the arrangement of the plant economy of operation as well as sanitation should be considered. It is desirable that the plant be so arranged that there will be a minimum of milk pumps and piping.

For convenience, economy, and sanitation the plant should be divided into the following separate rooms: Receiving room, pasteurizing or handling room, bottling room, washroom, byproducts room, milk-storage room, salesroom, offices, and laboratory. The boiler room should be separate from the rest of the plant.

Each room should be of ample size to accommodate the equipment it contains, with sufficient space for the men to work and to clean the equipment, but there should be no waste space.

The receiving room should be so arranged that the cans of milk will be transferred to the weigh can, and the empty cans from the can washer automatically, with a minimum of handling.

The bottles should be checked in on conveyors so arranged that there will be a minimum of stacking of bottles between the checking-in platform and the bottle washers. At small plants no transfer system is necessary if the bottle washer is placed near the checking-in platform.

Where a large number of routes are to be checked out, the system of loading out directly from the milk-storage room through several small doors or from several trailers is desirable. At small plants, loading out may be done direct from the milk-storage room through a door or with hand trucks or dollies.

There is a great variation in the number of men required to operate plants of similar capacities due, in a large measure, to the arrangement of the plants. Poorly arranged plants tend to increase the labor requirements. The labor requirements for operating plants of three or more stories are greater than those for plants of one or two stories.

A number of floor plans are presented in this circular as suggestions and guides for designing milk plants of various sizes.

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